

## How can applied mathematics support DOE's future challenges?

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Over the past half-century, the Applied Mathematics program in the U.S. Department of Energy's (DOE) Office of Advanced Scientific Computing Research has made significant, enduring advances in applied mathematics that have been essential enablers of modern computational science. Motivated by the scientific needs of the Department of Energy and its predecessors, advances have been made in mathematical modeling, numerical analysis of differential equations, optimization theory, mesh generation for complex geometries, adaptive algorithms and other important mathematical areas. The combination of these mathematical advances and the resulting software has enabled high-performance computers to be used for scientific discovery in ways that could only be imagined at the program's inception.

Recently, a panel of experts in applied, computational and statistical mathematics met to consider the broad science and engineering challenges that the DOE faces for the future. The panel revisited the goals of the DOE Applied Mathematics program in light of these evolving needs. They found that DOE scientists are being asked to identify or provide technology, or to give expert analysis to inform policy-makers that requires the scientific understanding of increasingly complex physical and engineered systems. Through studying the wide variety of these DOE applications, the panel identified corresponding applied mathematics research challenges in

- ◇ Predictive modeling and simulation of complex systems
- ◇ Mathematical analysis of the behavior of complex systems
- ◇ Using models of complex systems to inform policy makers

This presentation will examine DOE's future scientific and engineering challenges, and discuss the areas identified by the panel where new research in applied mathematics can significantly advance our ability to find scientific and engineering solutions to pressing problems of national interest. A number of fundamental mathematical areas where new mathematical research is needed are identified, and specific research opportunities that would significantly advance our capabilities in these areas are suggested.

### Panel

David Brown (chair)	Lawrence Livermore National Laboratory
John Bell	Lawrence Berkeley National Laboratory
Donald Estep	Colorado State University
William Gropp	University of Illinois Urbana-Champaign
Bruce Hendrickson	Sandia National Laboratories
Sallie Keller-McNulty	Rice University
David Keyes	Columbia University
J. Tinsley Oden	The University of Texas at Austin
Linda Petzold	University of California, Santa Barbara
Margaret Wright	New York University

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